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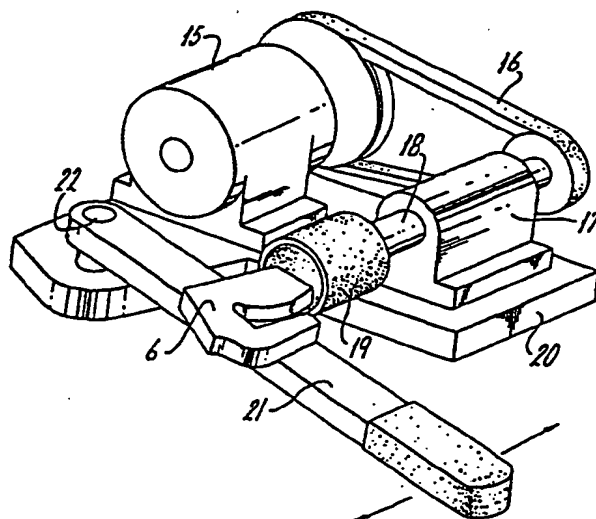
54 **Process and apparatus for machining a transverse element for a driving belt and transverse element.**

57 The invention relates to a process for machining a transverse element for a driving belt, which element is provided with a curved surface that can come into contact with an endless carrier of the driving belt.

The invention also relates to an apparatus for conducting the process and to the transverse element machined by means of the process.

Said driving belt consisting of a plurality of transverse elements which have been arranged slidably and also tiltably on an endless carrier, such as one or two metal band packages, one behind another in the longitudinal direction thereof, is liable to become worn in use. Due to a tilting movement as it enters between the sheaves of the V-shaped pulley the sharp edge of the curved surface of the transverse element comes into contact with the carrier and exerts a relatively very high pressure thereon.

In order to eliminate or in any case lessen this drawback and accordingly to provide a process for machining the curved surface of the transverse element is machined by means of a grinding device giving the surface a curvature in two mutually perpendicular directions.



**EP 0 143 293 A1**

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Process and apparatus for machining a transverse element for a driving belt and transverse element.

- 5 The invention relates to a process for machining a transverse element for a driving belt, which element is provided with a curved surface that can come into contact with an endless carrier of the driving belt.

- 10 The invention also relates to an apparatus for conducting the process and to the transverse element machined by means of the process.

- 15 The Netherlands patent application 7511879 filed in the name of the present applicant discloses a transverse element for a driving belt, also called a push element, a plurality of which can be slidably arranged on an endless carrier, such as one or two metal band packages, one behind another in the longitudinal direction thereof.

- 20 It has been found that when the belt has to transmit, a great power for a long period of time the carrier, i.e. one or two band packages, is in contact with the transverse elements in such a manner that the carrier(s) may be damaged. It has also been found that such damage or wear occurs in particular at places where the sides of the band packages can come into contact with the transverse elements.

- 25 To eliminate, or in any case lessen, this drawback the Netherlands patent application 7511879 proposes to have the

surface of the transverse element which is intended to come into contact with the inner surface of the carrier convexly curved in the transverse direction. Despite this proposed remedy, wear has still been encountered on the carrier (one of the bands in the band package). The fact is that in such a driving belt the push elements are made of a relatively hard material, e.g. metal, and so is the carrier. As the push elements (transverse elements) have been arranged slidably, hence with some clearance, and also tiltably on the carriers, the driving belt is liable to become worn in use with resultant rupture, because in tilting the sharp edge of the curved surface of a push element comes into contact with the carrier and exerts a relatively very high pressure thereon.

It is an object of the present invention to eliminate or in any case lessen this drawback and accordingly to provide a process of the type mentioned in the introductory paragraph, characterized in that the curved surface is machined by means of such relative movements of a grinding device vis-à-vis the curved surface that this surface is given a curvature in two mutually perpendicular directions.

It has been found that wear due to the relative movement of the transverse element vis-à-vis the carrier, resulting in belt rupture, is greatly reduced by the means provided according to the invention, because the machining according to the invention prevents the sharp edges of the curved surface from coming into contact with the carrier; in consequence, obviating the additional stresses earlier encountered in the carrier due to the transverse element making a tilting movement as it enters between the sheaves of the V-shaped pulley, whereby the sharp edge of the curved surface was pressed against the carrier.

In a preferred embodiment of the process according to the invention, the curved surface is machined with a cylindrical rotating grinding device provided on the

inside with an abrasive material, which device performs  
a relative rotation on the cylinder axis as well as a  
relative rotation on an axis perpendicular to the cylinder  
axis and conceived in a radial plane with regard to the  
5 cylinder.

A preferred embodiment of apparatus for conducting the  
process according to the invention is characterized in  
that it is provided with a cylindrical grinding device  
which is rotatable on a shaft and which is lined on the  
10 inside with an abrasive material, whilst it is also pro-  
vided with a clamping device for gripping the transverse  
element such that the grinding device and the clamping  
device perform a movement vis-à-vis one another following  
a circular orbit whose axis crosses the axis of the grinding  
15 device at right angles.

Admittedly, a process is known from the Netherlands patent  
application 7801101 in which a plurality of transverse  
elements disposed according to a circular pattern are  
machined simultaneously by means of an abrasive belt which  
20 removes more material on the sides than in the centre,  
but it has been found that this known process has disad-  
vantages in that it is not altogether reproducible and it  
does not enable the desired curvature to be attained under  
all conditions, among other things.

25 For a better understanding of the invention, embodiments  
of the process and apparatus according to the invention  
will now be described by way of example with reference to  
the accompanying drawings, in which

Fig. 1 is a diagrammatic cross-sectional view through a  
30 pulley over which a driving belt moves;

Fig. 2 diagrammatically shows two push elements;

Fig. 3 depicts a push element which can be fitted on a  
carrier consisting of two bands or band packages;

Fig. 4 is a perspective view of a device according to  
35 the invention;

Fig. 5 is a diagrammatic plan view of the device according to Fig. 4;

Fig. 6 diagrammatically shows two elevations of a variant design of the device according to Fig. 4 and 5; and

- 5 Fig. 7 is a diagrammatic view of a device according to the invention for the machining of transverse elements intended for driving belts.

The transmission belt 3 represented in Fig. 1, which is provided with push elements (transverse elements) 6, can be  
10 used for transmitting a relatively large torque between two V-shaped pulleys, one of which is designated by the reference numeral 1. The spacing between the sheaves of the two V-shaped pulleys can be varied so as to attain a stepless variable transmission ratio. In such an arrange-  
15 ment the torque is transmitted by means of a pushing force which is transferred through a number of push elements (transverse elements), on the understanding that the tension of the carrier 7 is at all times greater than the pushing force transmitted by the push elements 6 fitted  
20 on the carrier 7.

As appears from Fig. 1, the transverse element 6 is, upon its entry between the sheaves of the V-shaped pulley 1, forced slightly outwards in a radial direction, whilst the transverse elements 6 also go through a tilting move-  
25 ment vis-à-vis one another round the contact area 2. As a result, the edges 30 are pressed against the carrier 7, whereas contact with the curved surface 9 is lost to some degree. The tilting of the transverse elements vis-à-vis one another is made possible by the tapering face 5. In  
30 order to eliminate the adverse effects, the curved surface 9 is according to the invention also ground slightly convex in the "short" direction (Fig. 6). This treatment has the additional benefit of affording a smooth ride of the curved surface 9 on the carrier 7. The driving belt 3 (Fig. 1)  
35 therefore consists of a plurality of transverse elements 6

slidably arranged on an endless carrier 7. The transverse elements 6 are slightly tapered inwardly in cross-section (face 5 in Fig. 2), making it easier for the driving belt 3 to pass with a radius round the pulley 1 (Fig. 1). The number of transverse elements 6 arranged on the carrier 7 is such that they are in contact with one another and fill up the entire circumference. During operation of the driving belt 3 the tension in the carrier must be greater than the maximum pushing force that will be transmitted by the transverse elements 6 so as to prevent the straight portions of transmission belt 3 from sagging. The transverse elements 6 consist of a substantially non-deformable material and carrier 7 is formed, for example, by a package of metallic bands, i.e. a plurality of endless bands arranged one around another.

Fig. 2 presents a cross-sectional view of two transverse elements 6 which are positioned between the sheaves of the V-shaped pulleys 1. These elements 6 have a surface 9 shaped convexly in a direction perpendicular to the plane of drawing. The said elements 6 can tilt round a contact area 2. The space required for doing so is provided by the tapering face 5. The endless carrier 7 is accommodated in a recess 14.

Fig. 3 shows a front view of a transverse element 6 provided with two side faces 8 designed to cooperate with the sheaves of the V-shaped pulley, and a surface 9 over which the carrier 7 can be arranged. Both sides of the transverse element 6 have a recess 14 for accommodating the carrier 7. The two surfaces 9, intended for contacting the inside of a band package, are each of convex shape in the transverse direction.

Fig. 4 represents the apparatus for conducting the process according to the invention. It comprises a motor 15 which, through a driving belt 16, drives a grinding wheel 19 whose shaft 18 is supported on the bearing block 17. The motor

15 and the bearing block 17 are disposed on a frame 20.  
A swing arm 21 which can pivot on a shaft 22 is connected  
to the transverse element 6 with the aid of clamping devices  
not shown in the drawing. By pivoting of the swing arm 21  
5 on shaft 22, the surface 9 is given a convex shape according  
to the track thereby described, whilst at the same time a  
convex shape in a direction perpendicular to this track is  
imparted by the action of the cylindrical grinding wheel 19.  
Fig. 5 is a diagrammatic plan view of the equipment according  
10 to Fig. 4.

Fig. 6 represents a variant design of apparatus for conduc-  
ting the process according to the invention. In it, the  
curvature of the convex surface 9 in a direction perpendicu-  
lar to the main surfaces of the transverse element 6 is  
15 obtained by grinding with the aid of a grinding wheel 23  
whose rotation surface has a concave shape. The curvature  
in the plane of drawing for the surface 9 is obtained by  
causing the transverse element 6 to perform a reciprocating  
movement over a part of a circular track, as indicated by  
20 arrow 26.

Fig. 7 depicts a device for conducting the process according  
to the invention with which transverse elements of the type  
designated by the reference numeral 6 in Fig. 7 can be ground.  
The design employs a hollow cylindrical grinding wheel 27  
25 retained in a chuck 28 which can rotate on a shaft 30. In the  
grinding process, a transverse element 6 is moved over a  
track schematically indicated by the arrow 31. Again, a  
convex surface is obtained that is curved in two mutually  
perpendicular directions. The reference number 10 denotes a  
30 locking pin which is passed through holes 11 and 12 after the  
carrier 7 has been positioned in space 13.

It has been found that the application of transverse elements  
which have been machined according to the process of the  
invention and arranged on a carrier consisting of a band or  
35 band package diminished the load on the carrier. The convex

shape of the surface which comes into contact with the endless carrier 7 prevents the edges of the surface from exerting undesirable forces on carrier 7. With the known transverse element, these forces manifested themselves especially  
5 upon entry of the transverse element 6 between the sheaves of the V-shaped pulley.

In the foregoing the invention has been described with reference to embodiments in which the rotating grinding device is disposed fixedly in the radial direction during  
10 the grinding operation, whereas the transverse element is moved relative to the grinding device.

Within the purview of the invention comes also the embodiment in which the transverse element is held stationary during the grinding operation and the grinding device performs the requisite movements. A particularly advantageous  
15 embodiment is one in which two setups according to fig. 4 are applied, which are disposed opposite one another and can each rotate on their several, mutually parallel shafts (22), so that both surfaces 9 (Fig. 3) can be ground in one  
20 operation. During this treatment the transverse element 6 is held fixedly in position.



Claims.

1. A process for the machining of a transverse element for a driving belt, which element is provided with a curved surface that can come into contact with an endless carrier  
5 of the driving belt, characterized in that the curved surface is machined by means of such relative movements of a grinding device vis-à-vis the curved surface that this surface is given a curvature in two mutually perpendicular directions.
- 10 2. A process according to claim 1, characterized in that the curved surface is machined with the aid of a cylindrical rotating grinding device provided on the inside with an abrasive material, which device performs a relative rotation on the cylinder axis as well as a relative rotation  
15 on an axis perpendicular to the cylinder axis and conceived in a radial plane with regard to the cylinder.
3. Apparatus for conducting the process according to claim 1 or 2, characterized in that it is provided with a cylindrical grinding device which is rotatable on a shaft  
20 and which is lined on the inside with an abrasive material, whilst it is also provided with a clamping device for gripping the transverse element such that the grinding device and the clamping device perform a movement vis-à-vis one another along a circular orbit whose axis crosses the  
25 axis of the grinding device at right angles.
4. Apparatus according to claim 3, characterized in that it is provided with two grinding devices disposed symmetrically relative to the clamping device.
5. Transverse element for a driving belt of a continuously  
30 variable speed converter, which element is provided with a curved surface that can come into contact with an endless carrier, machined by means of the process according to claim 1 or 2.

Fig.1.

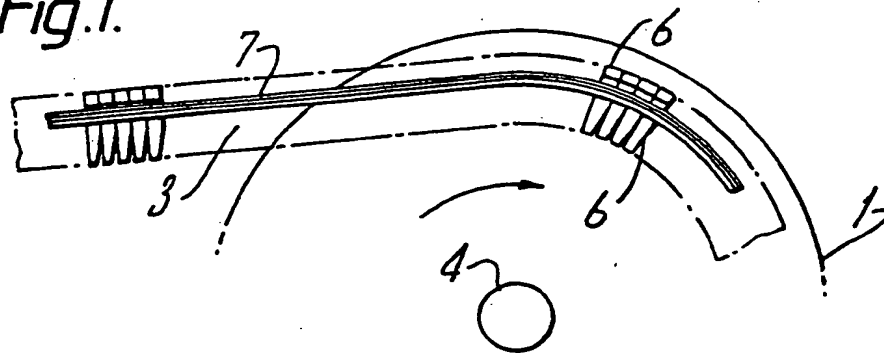


Fig.2.

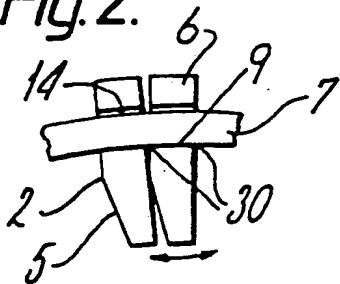


Fig.3.

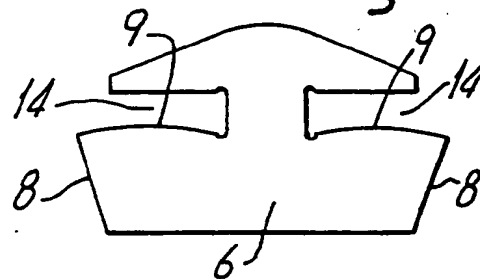
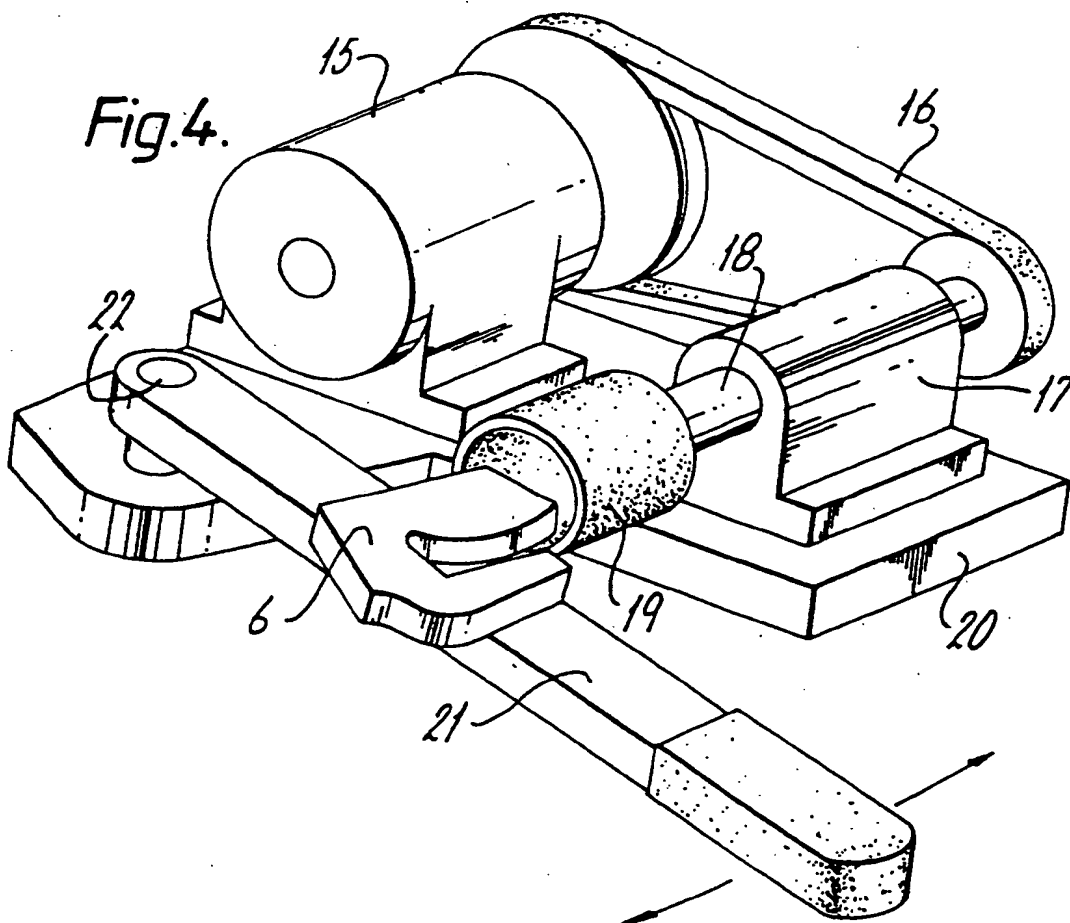
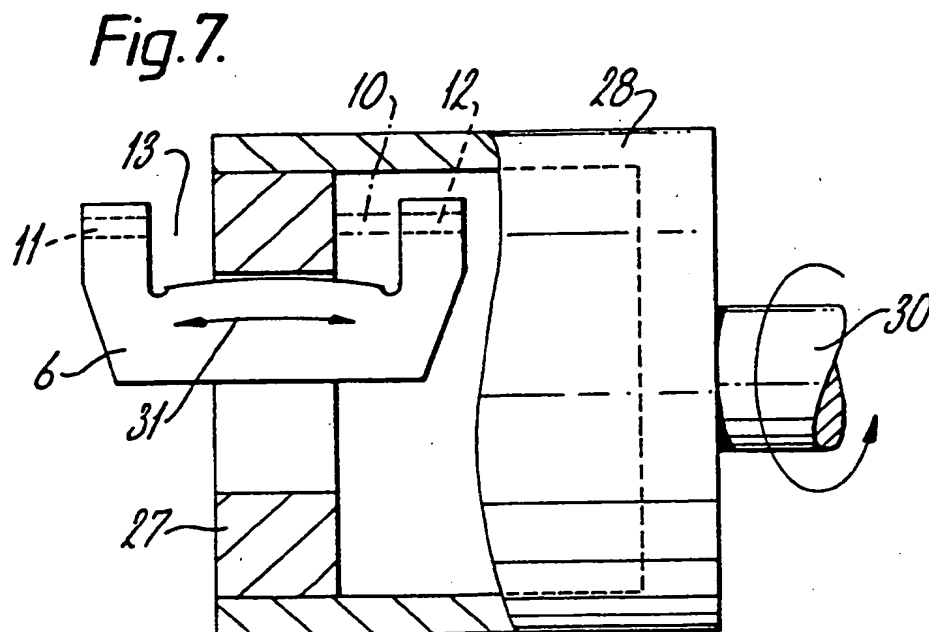
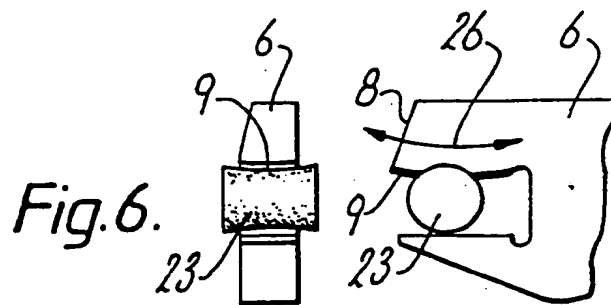
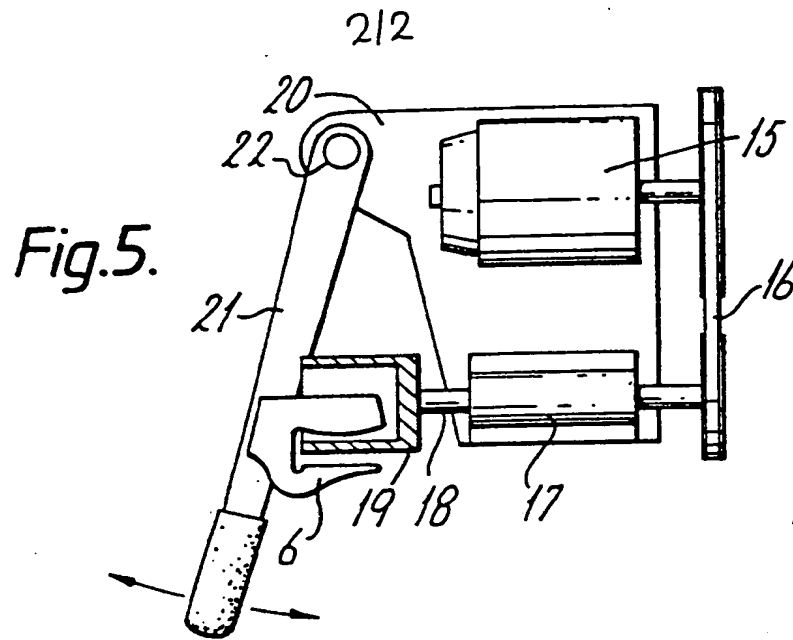


Fig.4.







European Patent  
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# EUROPEAN SEARCH REPORT

0143293  
Application number

EP 84 11 2254

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
X	IBM TECHNICAL DISCLOSURE BULLETIN Vol. 17, No. 12, May 1975, ARMONK, (US), J.E. PARKER et al.: "Grinding machine".  ---	1,2,5	B 24 B 19/26 F 16 G 5/16
A	NL-A-78 01 101 (VOLVO CAR B.V.) * Page 4, line 15 - page 6, line 12; figures 2,5 *	1	
A	CH-A- 94 507 (JULES BRUNNER) * Page 3, line 25 - page 4, line 14; figure 8-10 *	1-3	
A	PATENTS ABSTRACTS OF JAPAN, Vol. 7, No. 141, (M-223) (1286) June 21, 1983,  & JP-A-58 54 253 (NISSAN) (31-03-1983) * Whole document *	1-3	TECHNICAL FIELDS SEARCHED (Int. Cl. 4)  B 24 B F 16 G
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 12-12-1984	Examiner ESCHBACH D.P.A.
<b>CATEGORY OF CITED DOCUMENTS</b>			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons  & : member of the same patent family, corresponding document	

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